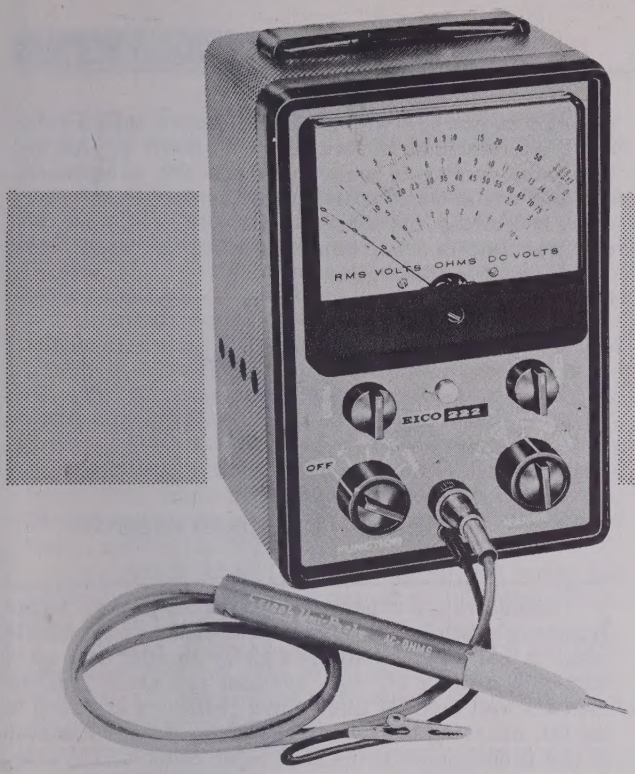



# 222

## CONSTRUCTION BOOK

# VTVM & UNI-PROBE

www.manualsplus.com
1026786

GENERAL INTRODUCTION

The EICO kit you are about to assemble and wire has been designed to meet the highest standards of performance. It is a high quality unit to be constructed from the finest components available anywhere.

The following Construction Book has been written to carefully guide you through the construction of your kit. If you follow all the instructions implicitly and work carefully without haste, you will be rewarded with many years of fine performance from this instrument and a personal inner satisfaction from a job well done.

The Construction Section: Beginning with the number on this page, and throughout the rest of the Construction Book, the page numbers are followed by a "C" (1C, 2C, etc.). The Instruction Manual, detailing the installation, operation and maintenance of your instrument, are identified by numerals only, without any letters following these numerals.

The Construction Manual pages are stapled together and slipped into the separately bound Instruction Manual. After you are certain that you have successfully completed the wiring of your kit, you may discard the Construction Manual. Keep the Instruction Manual for information as to the installation and operation, as well as for any maintenance that may be necessary in the future, on your unit.

Choosing a Workbench and Tools: To avoid the accidental loss or misplacement of components, choose a convenient workbench before unpacking your new kit. You will find it most advantageous to choose a corner on a table that will not be used for any other purpose until you have completed the construction of your kit. Proper precautions should be observed to prevent damage to any table top from a soldering iron or heavy tools.

When you check the component parts against the Parts List later on, it will be convenient to separate the various pieces into types of components and hardware sizes. It will be helpful to keep these sorted pieces separated in the compartments of specially made trays. Small cartons, egg trays or a refrigerator ice tray with dividers serve equally well.

Several basic tools are required to construct this kit. They are:

1. Screwdriver - 3/16" to 1/4" blade
2. Screwdriver - 1/8" blade
3. Longnose pliers - 5" or 6"
4. Gas pliers
5. Diagonal wire cutters
6. Soldering iron (100 watts), solder gun or pencil iron (35 watts).
7. High quality 60-40 rosin core radio solder. DO NOT use Acid Core solder or paste fluxes under any circumstances.

The following tools are useful, but are not absolutely necessary to construct this kit.

1. Socket wrench set
2. Open end wrench set
3. Wire stripper

Unpacking the Kit: This procedure serves two purposes. First, it lets you get acquainted with the various types of components. Second, it enables you to ascertain if you have received all the parts required to build the kit. This is your opportunity to have any packing errors corrected.

When unpacking, handle all parts carefully so that you will not damage any fragile components. Do not throw any packing material away until you have completed the checking of all components. Check each part off against the "Parts List" which you will find in your Instruction Manual. Check the packing for any small parts.

COPYRIGHT© 1961 ELECTRONIC INSTRUMENT COMPANY, Inc.

From time to time, due to modernization or possible error, it may be necessary to correct your Parts List. If there are any changes to be made, they will be listed on the loose addenda sheets included with this book. Make the corrections, if any, before checking the components. If no corrections of your Parts List are noted on the addenda sheets, or if there are no addenda sheets, assume that your Parts List is correct and commence to check all components against this list.

To enable rapid identification of electronic parts, each part has been assigned one or two letters of the alphabet called a "reference designation." These "reference designations" are nothing more than an initial letter or two representing the name of the part. For example, a vacuum tube has been assigned the "reference designation" letter "V", and a transformer the letter "T". Thus if you have two tubes and one transformer in your kit, these parts would be identified by the designations V1 and V2 and T1, respectively.

The reference designation assigned to capacitors is C.

The unit of capacitance is the "Farad". 1/1,000,000 of a Farad is the microfarad (abbreviated MF or MFD). 1/1,000,000 of a microfarad is a micro-microfarad (abbreviated MMF or MMFD). 1000 micro-microfarads is denoted by the letter "K". Thus 0.1mfd = 100Kmmf = 100,000mmf.

Some capacitors, such as electrolytics, have a plus (+) mark next to one lead. These are the only capacitors that must be mounted in a specific direction. Follow the directions for mounting described in the appropriate steps below. When no direction is mentioned, mount the capacitor either way.

The peak or working voltages are important capacitor characteristics. A capacitor marked with a higher voltage may be substituted for a lower voltage unit. Thus, a 50 volt capacitor may be used in place of a 10 volt unit. The reverse is obviously not true. You cannot use a 10 volt unit as a substitute for a 50 volt capacitor. Where more than one capacitor of identical value but different breakdown voltages are used, the unit you are to use is indicated in the appropriate construction step.

Resistors are denoted by the symbol letter R.

The unit of resistance is the "ohm". The letter "K" indicates multiplication by 1000 and the letter "M" indicates multiplication by 1,000,000. Thus 1000 ohm = 1K or 1 kilohm. 1,000,000 ohms = 1M or 1 megohm.

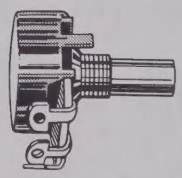
Some resistors have their resistance value stamped on the surface of the resistor body. However, other fixed resistors are coded with color bands which indicate their value. The actual color code of these resistors is noted in the parts list. In some instances, even when the color code is noted in the book, the actual resistor value may be stamped on the body, rather than the color code.

The tolerance of a resistor is the amount the resistance can vary around its marked value. Thus, if a 1K ohm (1000 ohms) resistor has a ± 10% tolerance, its actual value can be between 900 ohms and 1100 ohms. If the same resistor has a ± 5% tolerance, its actual value can be between 950 ohms and 1050 ohms. In all cases, the tolerance is always stated or given as part of the color code when the resistor is listed. If the resistor is marked with a number rather than a color code, the tolerance is stamped on the body. In your kit, 5% resistors may be substituted for 10% components and 10% resistors substituted for the 20% ones. However, be certain that you do not use a 10% resistor when a 5% resistor is required or a 20% resistor when a 10% or 5% resistor is specified.

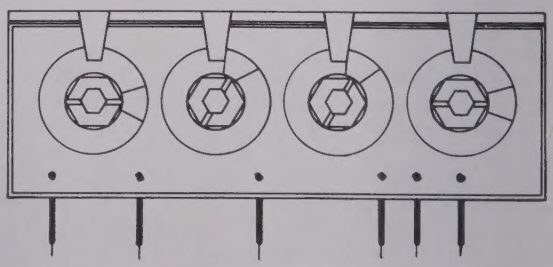
STANDARD RESISTOR

Resistors are capable of dissipating power. Large resistors handle more power while smaller ones handle less. A 1/4 watt resistor is usually smaller than a 1/2 watt unit, while a 1/2 watt resistor is usually smaller than a 1 watt unit. If like valued resistors are used in the kit, differing in power rating, the proper resistor to use is designated in the particular construction step.

Besides the fixed resistors discussed, there are also variable resistors known as potentiometers. They may be equipped with shafts on which a control knob may be mounted or may have a short shaft with a slotted end, requiring a small screwdriver for adjustment. Several potentiometers may be mounted on one board,



POTENTIOMETER, ROUND SHAFT



POTENTIOMETER BOARD

as shown. The latter types are generally used for infrequently made adjustments, such as for the calibration in the 222.

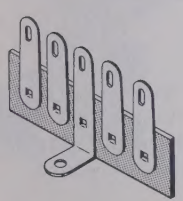
Switches are designated by the letter S. S1 refers to the switch assigned number 1. S2 refers to the switch assigned number 2. Switches may take several forms. The rotary switches have been assigned numbers S1 and S2.

On rotary switches, the front of the wafer is assigned one letter of the alphabet and the rear a second letter. If there is more than one wafer (such as is the case for S2 illustrated in the construction steps), the sides of the wafer are assigned more letters in sequence. Thus the front of the second wafer has been assigned letter "C" while the rear has been assigned letter "D". In the two wafer switch shown in Figure 4, S2-D10 refers to switch S2, the rear of the second wafer, solder lug #10.

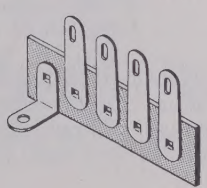
On switch S2 in figure 4, the second wafer has several solder lugs, but no rotor for switching functions. This wafer is designated by letter "X".

Turn the rotary switches to the maximum counterclockwise position. The exact position of the lugs referred to are determined by looking at the switch from the view shown in figure 4.

## TERMINAL STRIPS



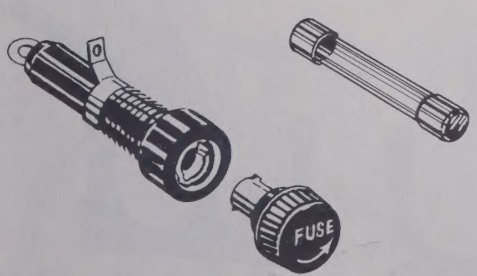
4 POST W/GND



4 POST RT.

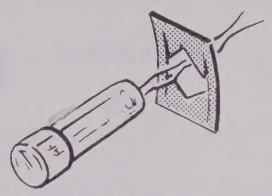
The various types of terminal strips are assigned the designation letters TB. The types used in this kit are illustrated.

## FUSEHOLDER & .5 AMP. FUSE




The fuse has been assigned a reference designation, F1, while the fuse holder is denoted by XF1.

## NEON BULB & CLIP



The reference designation given to the neon indicator is I1. The spring retainer is used to hold the bulb to the panel.

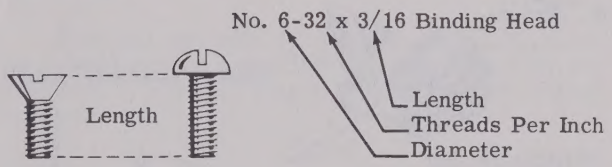
## HARDWARE

Hardware is a general term for mechanical parts used in the assembly of EICO kits. Such items are usually screws, nuts and washers. Machine screws are sized in accordance with the diameters of the threaded portion (No. 4, No. 6, No. 8) with the smaller number denoting the smaller diameter. The second number indicates the number of threads to an inch. Thus, a No. 6-32 screw has a No. 6 diameter with 32 threads per inch. The final number indicates the length of the threaded portion. A No. 6-32 x 3/8 screw has a 3/8" long threaded portion. The diameters are shown in the figure.

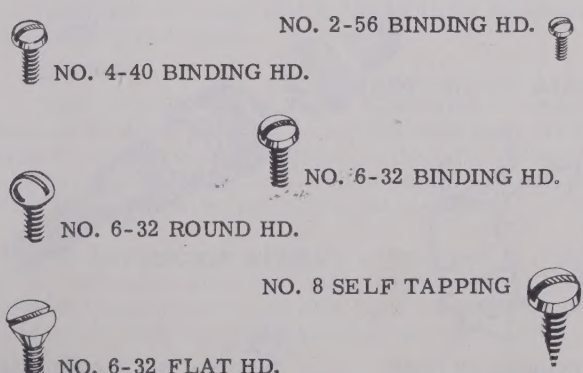
### ACTUAL SIZE OF DIAMETERS

NO. 2 ○ NO. 4 ○ NO. 6 ○ NO. 8 ○

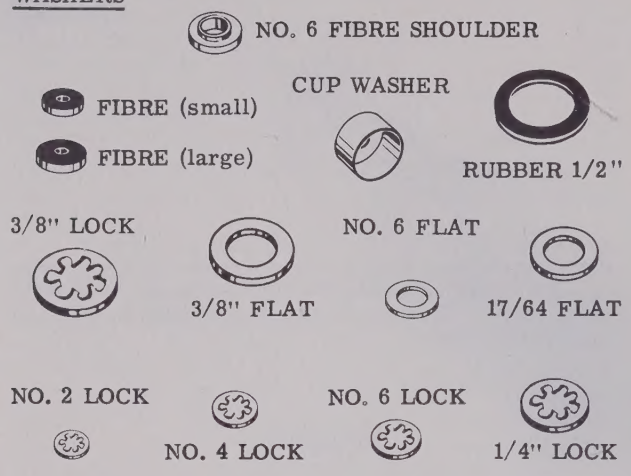
### EXAMPLE



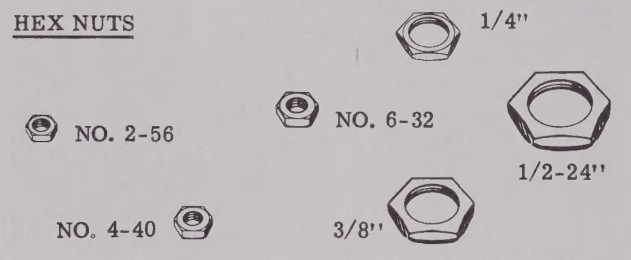

### SCREWS



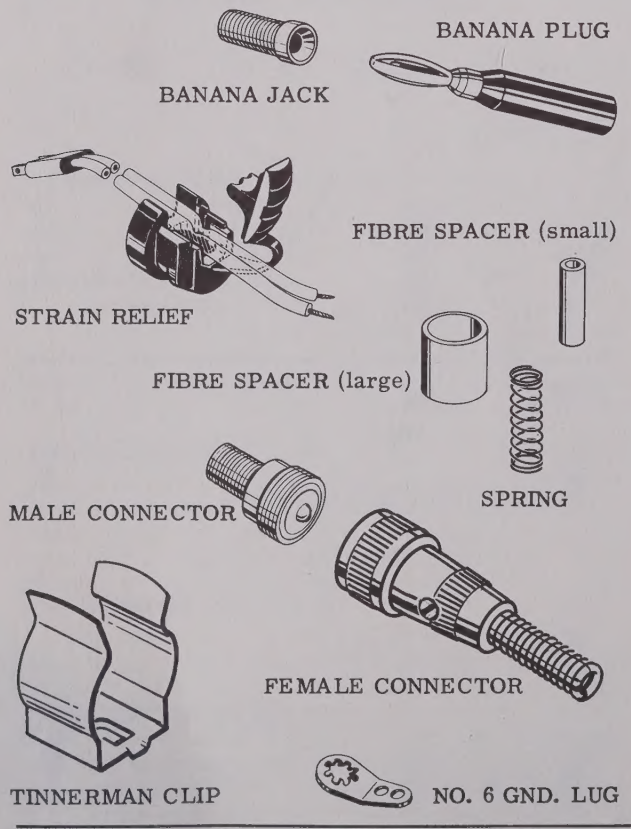
WASHERS




HEX NUTS




MISCELLANEOUS




The figure also shows the various head types in which these screws are supplied. Use the type specified in the particular step.

Washers and nuts are sized in accordance with the diameter of the screws they are used with.

Various types of washers are supplied. A lockwasher may have internal or external teeth. A flat washer is made out of flat metal. Fiber and bakelite washers are used for insulating devices. They generally separate two metallic pieces of hardware. Tinnerman speed nuts are generally used to mount a chassis cover or bottom plate.

Self tapping screws are used where it is not desirable to hold the screw to the chassis by a nut. The screw actually taps the threads in the metal into which it is screwed. The sizes are designated by numbers similar to those used for machine screws, with the smaller number indicating a smaller diameter screw.

Most of the other component parts used with the kit are self evident and require little further explanation or description.

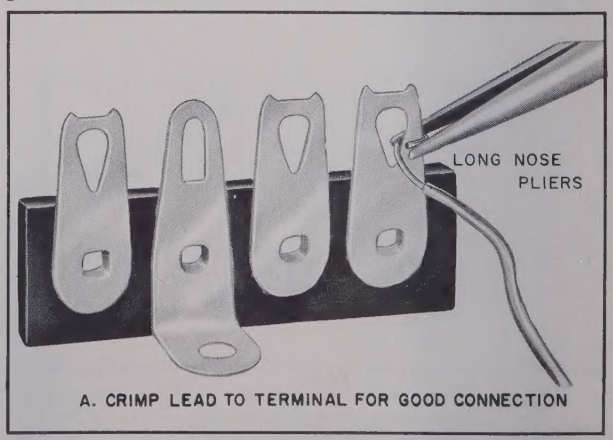
If after having checked all your components against the parts list, you find a shortage, please write us at:

Customer Service
Electronic Instrument Co., Inc.
33-00 Northern Blvd.
Long Island City 1, N.Y.

Include the inspection slip, with your letter, describing the shortage. If there is a slight hardware shortage, you can expedite matters by purchasing these pieces at your local jobber or hardware store.

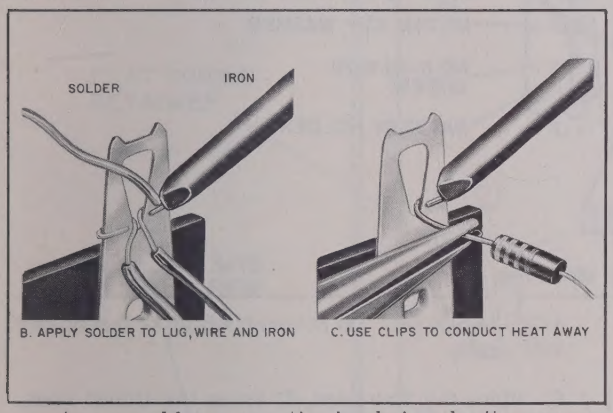
SOLDERING

Soldering Techniques: To get a good, clean connection, use the soldering techniques described below. USE THE BEST GRADE OF ROSIN CORE RADIO SOLDER ONLY. UNDER NO CIRCUMSTANCES SHOULD ACID CORE SOLDER OR ACID FLUX BE USED. The use of acid core solder or acid paste fluxes can cause serious corrosion and will void all the repair and service guarantees.

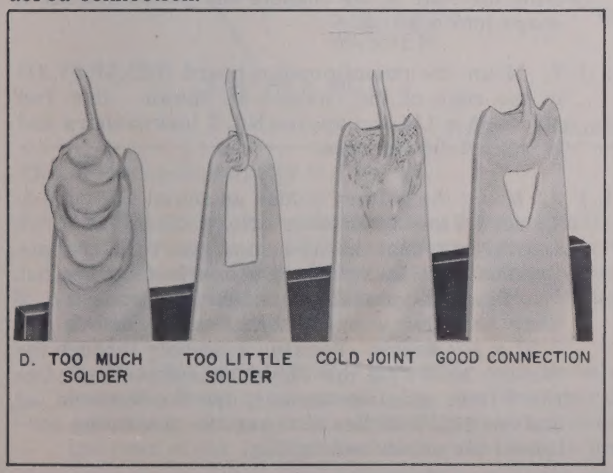


The soldering and wiring techniques described below should be practiced several times before attempting to wire or solder components in the actual kit. Practice several connections with a spare piece of wire and a socket or terminal strip that can be purchased at your local jobber.

First make a good mechanical connection. Remove 1/4" of insulation from the end of the wire. Feed the wire through the solder lug opening so that the wire insulation just touches the lug. With the long-nose pliers, bend the wire lead around the lug and crimp the wire lead to the lug. To solder the connection, place the tip of the hot soldering iron on the lug or terminal at a point close to the wire being soldered. Apply the solder to the junction of the lug, wire and soldering iron. When the lug and wire have been heated to the correct temperature, the solder will flow into and over the joint. Remove the iron when the solder starts to flow and remove the solder immediately after. Use only enough solder to cover the wire at the connection point. To get good heat conduction from the iron to the joint, remove scales from the iron tip with steel wool and keep the iron freshly tinned.




A poor solder connection is obvious by its appearance. A grainy or pitted joint is a poor connection due to insufficient heat. Blobs of solder on the wire or solder lug is also due to insufficient heat. Solder should flow as a result of the heated lug and wire. Do not solder by applying solder to the iron tip and then wiping the hot solder onto the joint. A well soldered joint is indicated by a smooth shiny finish on the soldered connection.




Construction Hints: The various lengths of wire to be used in the kit are specified in the construction steps. After cutting the wire to the length specified, strip the insulation off 1/4" from each end. The exposed wire will be used to make the actual connection to the solder lug.

Components, such as resistors and neon indicator lamps, may have longer leads than specified. Cut the leads to the length indicated in the particular construction step. This length is to be measured from the body of the component. In the case of insulated leads, strip 1/4" of insulation off from the ends and twist the strands (if any) of the wire together.

As an example, one step may specify that each lead on a resistor be cut to 1/2". 1/4" of each lead is used to make a mechanical connection to the solder lug. The other 1/4" is between the terminal board and the component so that the component will not be overheated when soldering.

When a connection is indicated, a (C) or an (S) will appear next to the lug involved, when appropriate. The (C) indicates that the connection should be simply mechanical without soldering, since other leads are to be connected to this same lug. The (S) indicates that the connection should be made and soldered immediately. However, the (S) is always followed by a number, such as (S1), (S2), (S3), etc. This number indicates the number of connections made to the lug. It is a check on the accuracy of your work.

As an example, if it says (S3) you should count three leads going to the lug to be soldered. If there are less than three leads at this particular lug, you will know that you have forgotten one or more leads, or connected them to the wrong lugs. If there are more than three leads, you can be certain you have connected an extra wire to this lug, which should probably go elsewhere.

When you assemble the parts in your unit, mark the symbol of each component on the chassis near the part, with a crayon. This will facilitate your wiring operation.

When wiring, dress the leads and components as shown in the drawing. Be careful to avoid shorts at the lugs. The book is written so that the wiring closest to the chassis will usually be wired first. A second and third layer of wires will be connected in sequence and placed above these.

Next to each step number you will find a parenthesis ( ). After you have completed each step, make a check mark in the parenthesis so that you will have a record of your work. Follow the steps in the sequence given in the book. Do not skip steps or pages.

If any addendas are included in your book to modernize your instrument or to make corrections or part substitutions, be sure to correct the Construction Book first before you start to assemble and wire you kit.

You are now ready to construct your fine VTVM.

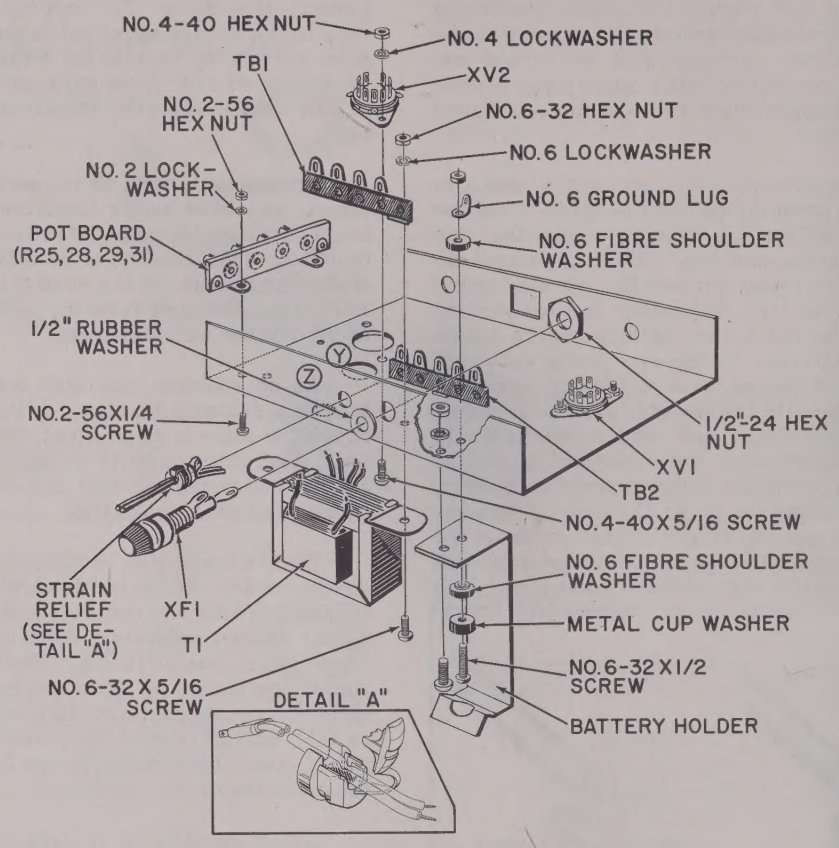



Figure 1. Chassis Mounting

The following steps refer to figure 1.

( ) 1. Mount the 9 pin miniature socket XV2 to the chassis as shown. Check position of keyway (missing socket pin) on figure 5. Use two No. 4-40 x 5/16 screws, two No. 4 lockwashers and two No. 4-40 hex nuts.

( ) 2. Mount the 7 pin miniature socket XV1 to the chassis as shown. Check position of keyway (missing socket pin) on figure 5. Use two No. 4-40 x 5/16 screws, two No. 4 lockwashers and two No. 4-40 hex nuts.

( ) 3. Mount the 4 post with ground terminal strip, TB2 to the chassis as shown. Use one No. 6-32 x 5/16 screw, one No. 6 lockwasher and one No. 6-32 hex nut.

( ) 4. Mount power transformer, T1, to top of the chassis. Pass the black leads through hole "Z" and the remaining leads through the larger hole "Y". The four post right terminal strip, TB1, is mounted on the transformer mounting screw near the center of the chassis. Use two No. 6-32 x 5/16 screws, two No. 6 lockwashers and two No. 6-32 hex nuts.

( ) 5. Place a 1/2" rubber washer over the fuseholder, XF1. Insert the fuseholder from the rear in the D-shaped hole on the rear apron. Secure with a 1/2"-24 hex nut. Do not overtighten or fuseholder will crack.

( ) 6. Place the line cord, 2" from the tinned ends, onto the groove of the larger section and between the two sections of the two piece strain relief, with the tinned ends toward the smaller section. Bend the smaller section over the line cord and position in the channel of the larger section. Compress the two sections together with a plier grasping the largest diameter end of the strain relief. Pass the tinned ends of the line cord through the hole from the rear of the chassis and press in until it snaps into position.

( ) 7. Mount the potentiometer board (R25,28,29,31) to the edge of the chassis as shown. Use two No. 2-56 x 1/4 screws, two No. 2 lockwashers and two No. 2-56 hex nuts.

( ) 8. Mount the battery holder as shown in figure 1. To secure the holder pass a No. 6-32 x 5/16 screw into the hole nearest the rear apron of the chassis. Use one No. 6 lockwasher and one No. 6-32 hex nut.

Place the metal cup washer and one No. 6 fibre shoulder washer, in that order, onto a No. 6-32 x 1/2 screw. Pass the assembly through the battery holder on the top of chassis. Place one No. 6 fibre shoulder washer, one No. 6 ground lug and one No. 6-32 hex nut over the remaining portion of the screw and tighten.

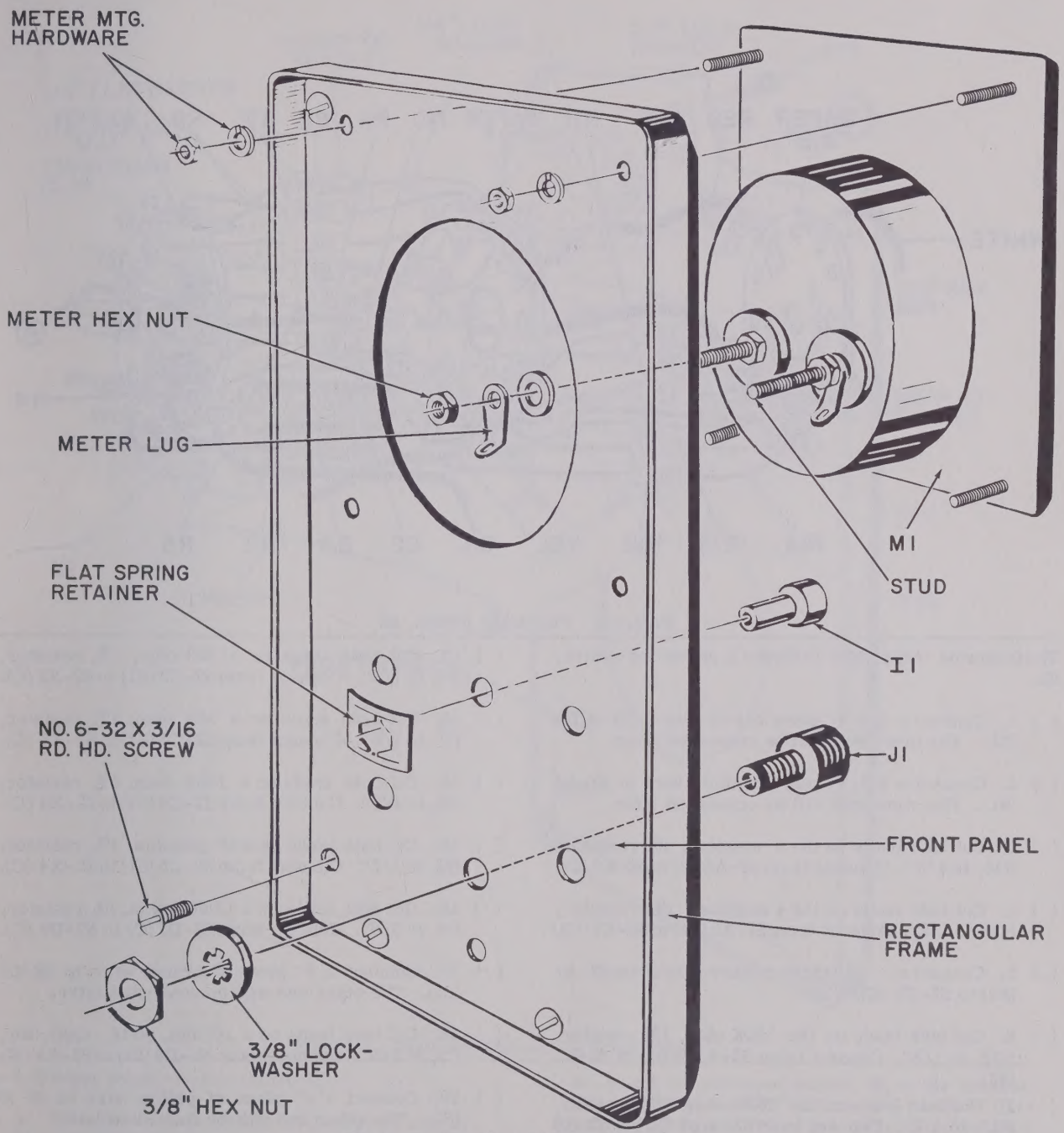



Figure 2. Panel and Meter Mounting

The following steps refer to figure 2.

( ) 1. Place the rectangular frame on the work table, with the tapped screw holes up towards you. Insert the panel face (printed side) down into the frame. Secure the panel to the frame with ten No. 6-32 x 3/16 round head screws.

( ) 2. Pass the neon indicator bulb I1 through its hole from the front of the panel. Use the flat spring retainer to secure bulb. Press the retainer over the rear of the bulb while holding the bulb to the front panel with your hands or resting it against a small wooden block.

( ) 3. Mount the male connector, J1, to the front panel as shown. Use a 3/8" lockwasher and a 3/8" hex nut.

( ) 4. Mount the meter, M1, to the panel. Use the hardware supplied with the meter.

( ) 5. Remove the shorting wire from the meter studs. On each stud place a flat washer, meter lug and meter nut. Use hardware supplied with meter.

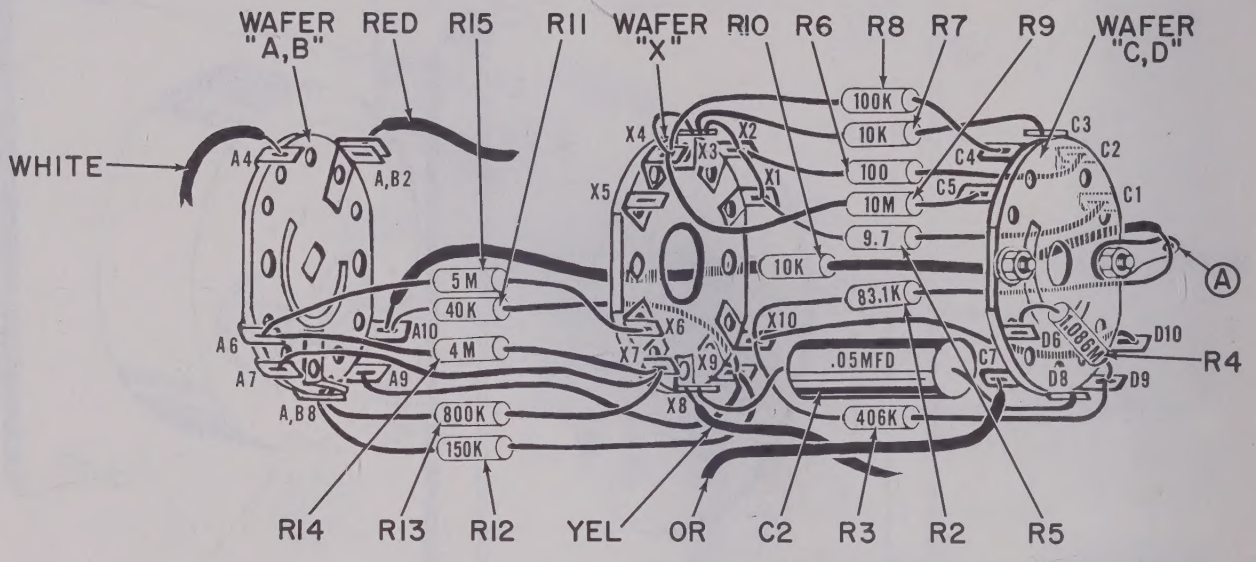



Figure 3. Prewiring Switch, S2

The following steps refer to figure 3, prewiring switch, S2.

( ) 1. Connect a 4-3/4" piece of red wire to S2-A,B2 (S1). The other end will be connected later.

( ) 2. Connect a 4-1/4" piece of white wire to S2-A4 (S1). The other end will be connected later.

( ) 3. Cut both leads on the 5 megohm, 1% resistor, R15, to 1/2". Connect from S2-A6 (C) to S2-X6 (C).

( ) 4. Cut both leads on the 4 megohm, 1% resistor, R14, to 1/2". Connect from S2-A6 (S2) to S2-X7 (C).

( ) 5. Connect a 1-1/2" piece of bare wire from S2-A7 (S1) to S2-X7 (C).

( ) 6. Cut both leads on the 800K ohm, 1% resistor, R13, to 1/2". Connect from S2-A,B8 (C) to S2-X7 (S3).

( ) 7. Cut both leads on the 150K ohm, 1% resistor, R12, to 1/2". Connect from S2-A,B8 (S2) to S2-X9 (C).

( ) 8. Connect a 1-1/2" piece of bare wire from S2-A9 (S1) to S2-X9 (C).

( ) 9. Cut both leads on a 40K ohm, 1% resistor, R11, to 1/2". Connect from S2-A10 (C) to S2-X9 (S3).

( ) 10. Cut both leads on a 10K ohm, 1% resistor, R10, to 1-3/4". Cover both leads with a piece of 1/2" spaghetti tubing. Connect from S2-A10 (S2) to ground lug "A" on wafer "C,D" (C).

( ) 11. Cut both leads on a 9.7 ohm, 1%, resistor, R5, to 1/2". Connect from S2-C1 (S1) to S2-X1 (C).

( ) 12. Cut both leads on a 100 ohm, 1%, resistor, R6, to 1/2". Connect from S2-C2 (S1) to S2-X2 (C).

( ) 13. Cut both leads on a 10K ohm, 1%, resistor, R7, to 1/2". Connect from S2-C3 (S1) to S2-X3 (C).

( ) 14. Cut both leads on a 100K ohm, 1%, resistor, R8, to 1/2". Connect from S2-C4 (S1) to S2-X4 (C).

( ) 15. Cut both leads on a 10 megohm, 1%, resistor, R9, to 1/2". Connect from S2-C5 (S1) to S2-X4 (C).

( ) 16. Cut both leads on a 1.086M ohm, 1%, resistor, R4, to 3/8". Connect from S2-D6 (C) to S2-D9 (C).

( ) 17. Connect a 5" piece of orange wire to S2-C7 (S1). The other end will be connected later.

( ) 18. Cut both leads on a .05mfd, 400V, capacitor, C2, to 5/8". Connect from S2-D8 (S1) to S2-X8 (C).

( ) 19. Connect a 4" piece of yellow wire to S2-X8 (S2). The other end will be connected later.

( ) 20. Cut both leads on a 406K ohm, 1% resistor, R3, to 1/2". Connect from S2-D9 (S2) to S2-X10 (C).

( ) 21. Connect a 1-1/2" piece of bare wire from S2-D10 (S1) to S2-X10 (C).

( ) 22. Cut both leads on a 83.1K ohm, 1% resistor, R2, to 1/2". Connect from ground lug "A" on wafer C,D of S2 (S2) to S2-X10 (S3).

( ) 23. Connect a 2-1/2" piece of bare wire to S2-X4 (S3). Pass the other end of the wire through S2-X3 (S3), S2-X2 (S3) and S2-X1 (C).

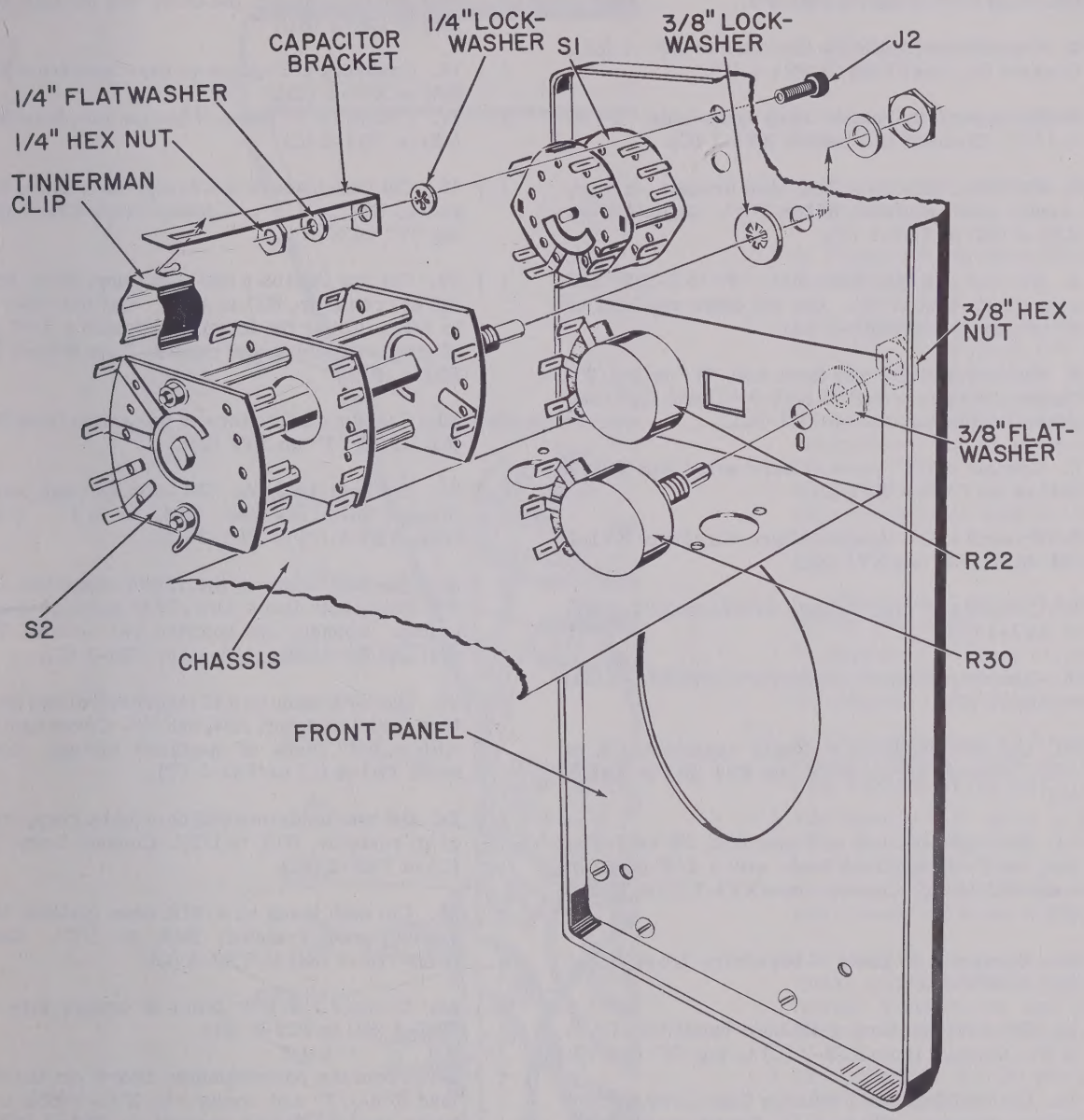



Figure 4. Mounting Chassis to Front Panel

The following steps refer to figure 4.

( ) 1. Place the chassis against the front panel assembly with the potentiometer mounting holes in line.

( ) 2. Mount the 2K ohms adjust potentiometer, R30, to the chassis. Rotate R30 so that the locating lug slips into the oblong hole provided for it on the front apron. Secure R30 with one 3/8" flatwasher and one 3/8" hex nut.

( ) 3. In a similar manner mount the other 2K ohms potentiometer, R22, to the chassis as shown. Use one 3/8" flatwasher and one 3/8" hex nut.

NOTE: The following steps should not be done until after the preliminary wiring in fig. 5 is completed.

( ) 4. Mount the prewired switch, S2, to the chassis. Secure it with one 3/8" lockwasher, one 3/8" flatwasher and one 3/8" hex nut. Note the orientation in figure 4.

( ) 5. Mount S1 to the front panel as shown in figure 4. Secure with one 3/8" lockwasher, one 3/8" flatwasher and one 3/8" hex nut.

( ) 6. Snap the Tinnerman clip on the capacitor bracket as shown.

( ) 7. Insert J2 from the front of the panel in the hole marked "G". On the other end place a 1/4" lockwasher, the capacitor bracket, a 1/4" flat washer and a 1/4" hex nut in that sequence. Note orientation of bracket in figure 4.

The following steps refer to figure 5.

( ) 1. Connect one lead of the line cord to XF1-1 (S1). Connect the other lead to TB1-1 (C).

( ) 2. Cut one of the black leads from hole "Z" to 2-1/2". Connect this lead to XF1-2 (C).

( ) 3. Cut both leads on a 33K ohm (orange, orange, orange, gold) resistor, R17 to 1/2". Connect from XF1-2 (S2) to TB2-1 (C).

( ) 4. Cut one red lead from hole "Y" to 2-1/2" and connect to TB2-2 (C). Cut the other red lead to 4" and connect to XV1-2 (S1).

( ) 5. Cut both green leads from hole "Y" to 1-1/2". Connect one green lead to XV2-5 (C) and the other green lead to lug "U" on XV2 (S1).

( ) 6. Connect a 1/2" piece of bare wire from XV1-1 (S1) to lug "X" on XV1 (S1).

( ) 7. Connect a 1/2" piece of bare wire from XV1-3 (S1) to lug "W" on XV1 (S1).

( ) 8. Connect a 4" piece of grey wire from XV1-4 (S1) to XV2-4 (C).

( ) 9. Connect a 4" piece of red wire from XV1-5 (S1) to TB1-2 (C).

( ) 10. Cut both leads on a .05mfd capacitor, C3, to 3/4". Connect from lug "V" on XV1 (S1) to TB2-5 (C).

( ) 11. Cut both leads on a 4 megohm, 1% resistor, R18, to 1". Cover both leads with a 3/4" piece of spaghetti tubing. Connect from XV1-7 (C) to TB2-5 (C).

( ) 12. Connect a 1" piece of bare wire from XV2-1 (S1) to XV2-6 (C).

( ) 13. Cut both leads on a .003mfd capacitor, C4 to 3/4". Connect from XV2-2 (C) to lug "T" on XV2.

( ) 14. Cut both leads on a 680 ohm (blue, grey, brown, silver) resistor, R20 to 3/4". Cover one lead with spaghetti tubing and connect to XV2-3 (C) and the other lead to R22-3 (S1).

( ) 15. Connect a 3-1/2" piece of grey wire from XV2-3 (C). Connect the other end through R30-1 (S2) to R30-2 (S1).

( ) 16. Connect a 1/2" piece of bare wire from XV2-4 (S2) to XV2-5 (S2).

( ) 17. Connect a 3" piece of brown wire from XV2-6 (S2) to TB1-2 (C).

( ) 18. Cut both leads on a 4.7 megohm (yellow, violet, green) R27, to 1/2". Connect from XV2-7 (S1) to lug "T" on XV2 (C).

( ) 19. Cut one lead on a 680 ohm (blue, grey, brown, silver) resistor, R21 to 3/4". Cut the other lead to 1/2". Cover the longer lead with a 1/2" piece of spaghetti tubing and connect from XV2-8 (C) to R22-1 (S1).

( ) 20. Connect a 1/2" piece of bare wire from XV2-9 (S1) to lug "T" on XV2 (S3).

( ) 21. Cut both leads on 33K ohm (orange, orange, orange, gold) resistor, R26, to 1/2". Connect from TB1-2 (C) to TB1-3 (C).

( ) 22. Cut both leads on the 10mfd capacitor, C5, to 1". Cover both leads with a 3/4" piece of spaghetti tubing. Connect the positive (+) lead to TB1-2 (S4) and the minus (-) lead to TB2-2 (C).

( ) 23. Cut both leads on a 43 megohm (yellow, orange, blue, gold) resistor, R24, to 3/4". Cover both leads with a 1/2" piece of spaghetti tubing. Connect from TB1-4 (C) to TB2-5 (C).

( ) 24. Cut both leads on a 68K ohm (blue, grey, orange, gold) resistor, R16, to 1/2". Connect from TB2-2 (C) to TB2-3 (S1).

( ) 25. Cut both leads on a 47K ohm (yellow, violet, orange, gold) resistor, R23, to 1/2". Connect from TB2-2 (S4) to TB2-4 (C).

( ) 26. Connect a 3-1/2" piece of orange wire from TB2-4 (S2) to R22-2 (S1).

( ) 27. From the potentiometer board cut the brown lead to 3-1/2" and connect to XV2-3 (S3); cut the white lead to 2" and connect to TB1-3 (S2); the green lead to 1-1/2" and connect to TB1-4 (S2).

( ) 28. At this point, complete steps 4 to 7 on page 9C, figure 4.

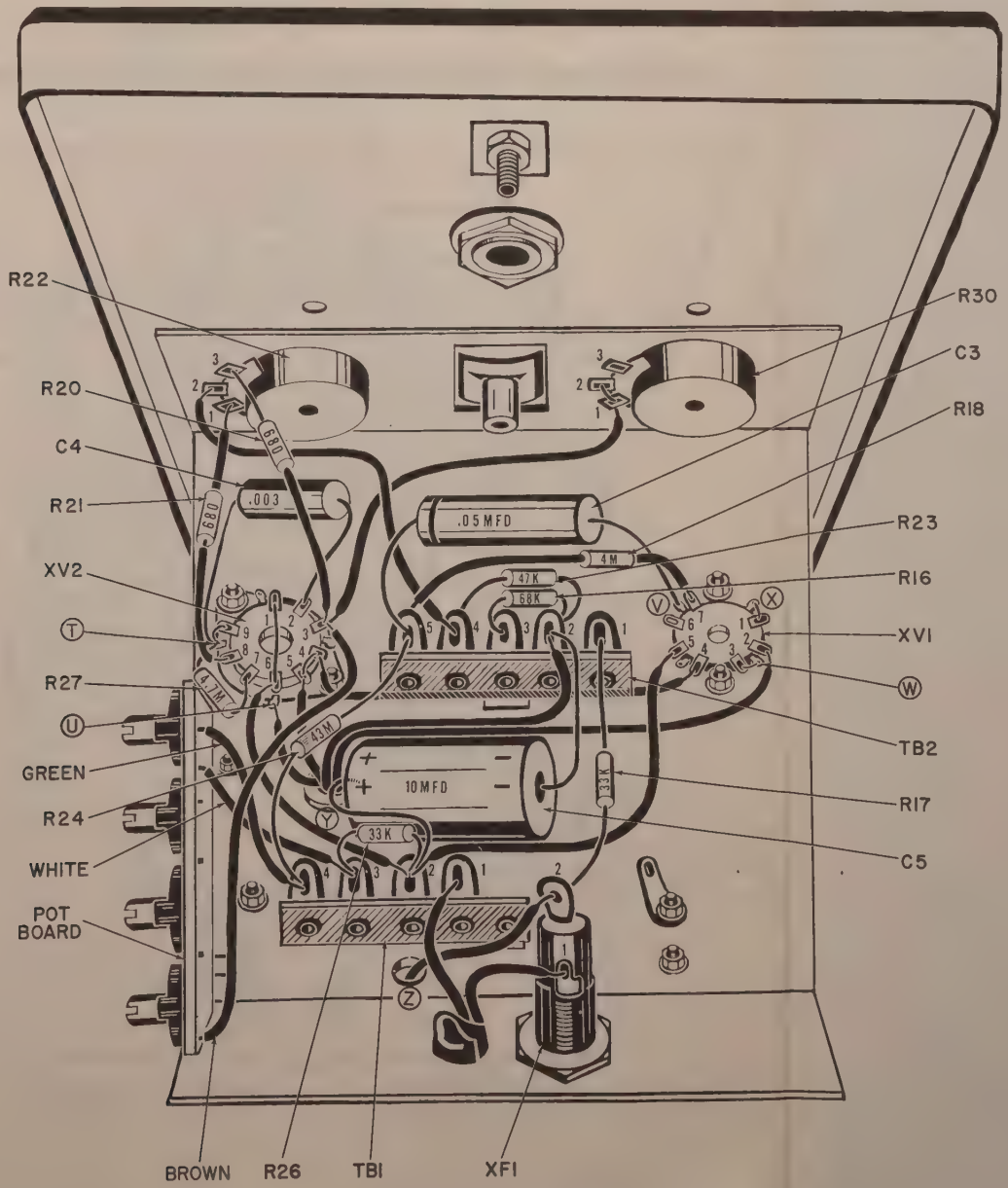



Figure 5. Chassis Wiring

The following steps refer to figure 6.

( ) 1. Connect the prewired white lead from S2-A4 to S1-B5 (S1).

( ) 2. Connect a 6" piece of grey wire from S2-X6 (S2) to S1-A11 (S1).

( ) 3. Connect the prewired red lead from S2-A,B2 to S1-B3 (S1).

( ) 4. Connect the prewired orange lead from S2-C7 to S1-B7 (S1).

( ) 5. Connect a 2" piece of grey wire from S1-A8 (S1) to J1 (S1). Strip about 3/8" off the end of the wire and slip into the hole on J1. Solder the wire to J1 from the outside making certain that the solder flows into the hole and does not accumulate on the top surface. Cut off any excess wire.

( ) 6. Cut both leads on a .1mfd capacitor, C1, to 1". Cover both leads with a 3/4" piece of spaghetti tubing. Connect from S1-B9 (S1) to S2-D6 (S2). Snap C1 into the prongs of the capacitor bracket.

( ) 7. Connect a 6" piece of green wire from S1-A12 (S1) to TB2-5 (S4).

( ) 8. Connect a 6" piece of red wire to S1-C2 (S1). Pass the other end through hole "S" to the top of the chassis. It will be connected later.

( ) 9. Cut both leads on a 3.3 megohm (orange, orange, green) resistor, R19, to 1/2". Connect from XV2-2 (S2) to S1-A4 (S1).

( ) 10. Connect a 6" piece of brown wire to TB1-1 (S2). Cut the remaining black lead from hole "Z" to 4". Twist the black and brown leads together as shown. Connect the brown lead to S1-D3 (S1) and connect the black lead to S1-D4 (C).

( ) 11. Cut both leads on neon indicator I1, to 2". Cover both leads with 1-3/4" piece of spaghetti tubing. Connect one lead to S1-D4 (S2) and the other lead to TB2-1 (S2).

( ) 12. Connect a 2-1/2" piece of black wire from S1-C6 (S1) to R30-3 (S1).

( ) 13. Connect a 5" piece of brown wire to S1-C8 (S1). Pass the other end through hole "S" to the top of the chassis. It will be connected later.

( ) 14. Connect the yellow wire from S2-X8 to XV1-7 (S2).

( ) 15. Connect a 2" piece of red wire from XV2-8 (S2) to S1-C11 (S1).

( ) 16. Connect a 3" piece of green wire from ~~XV2-8~~ Sq X1 (S2) to ~~S1-C11 (S1)~~ Term R (Solder).

( ) 17. Cut the red lead from the potentiometer board to 3"; the black lead to 3-1/2"; the yellow lead to 3-1/2". Connect the red lead to S1-C10 (S1); the black lead to S1-C9 (S1); the yellow lead to S1-C5 (S1).

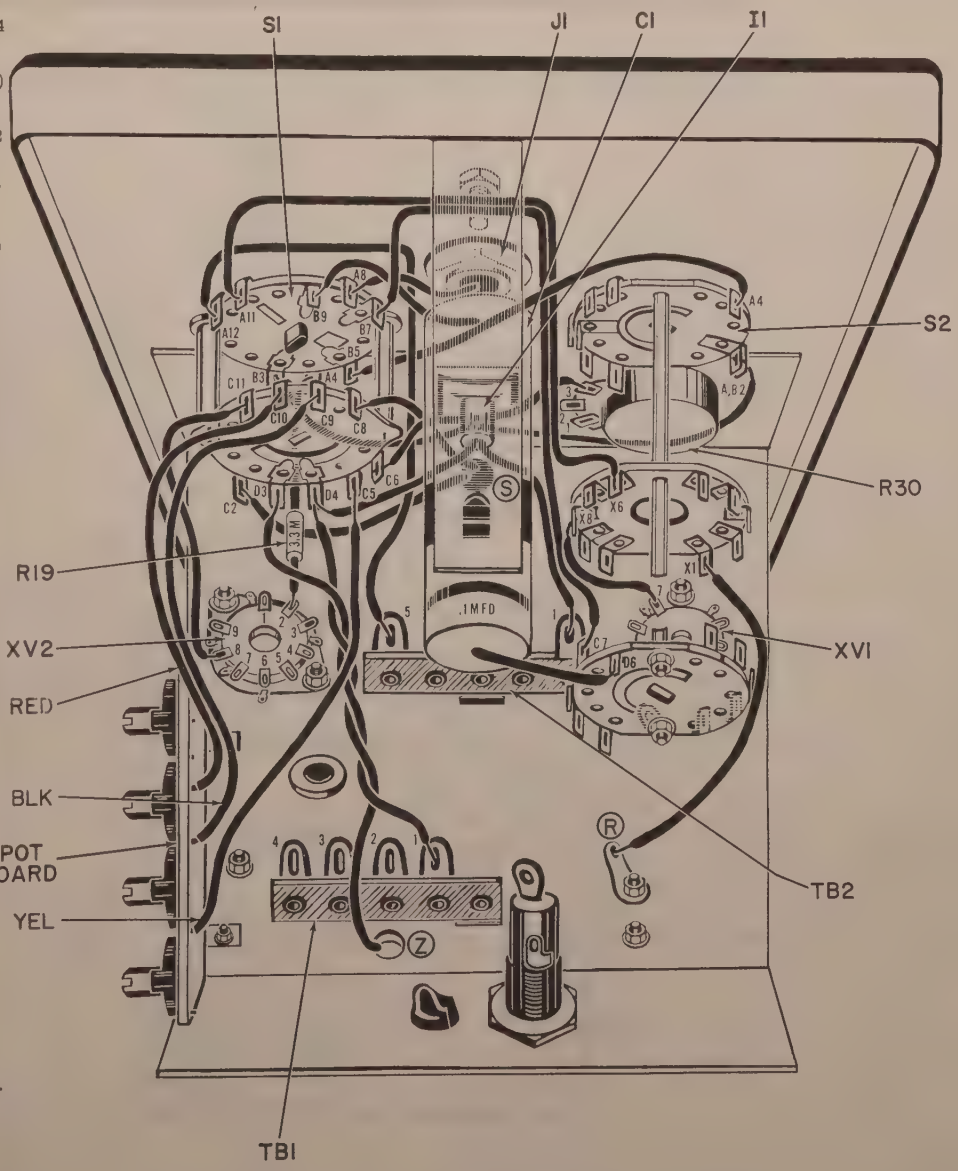



Figure 6. Chassis Wiring (Cont'd.)

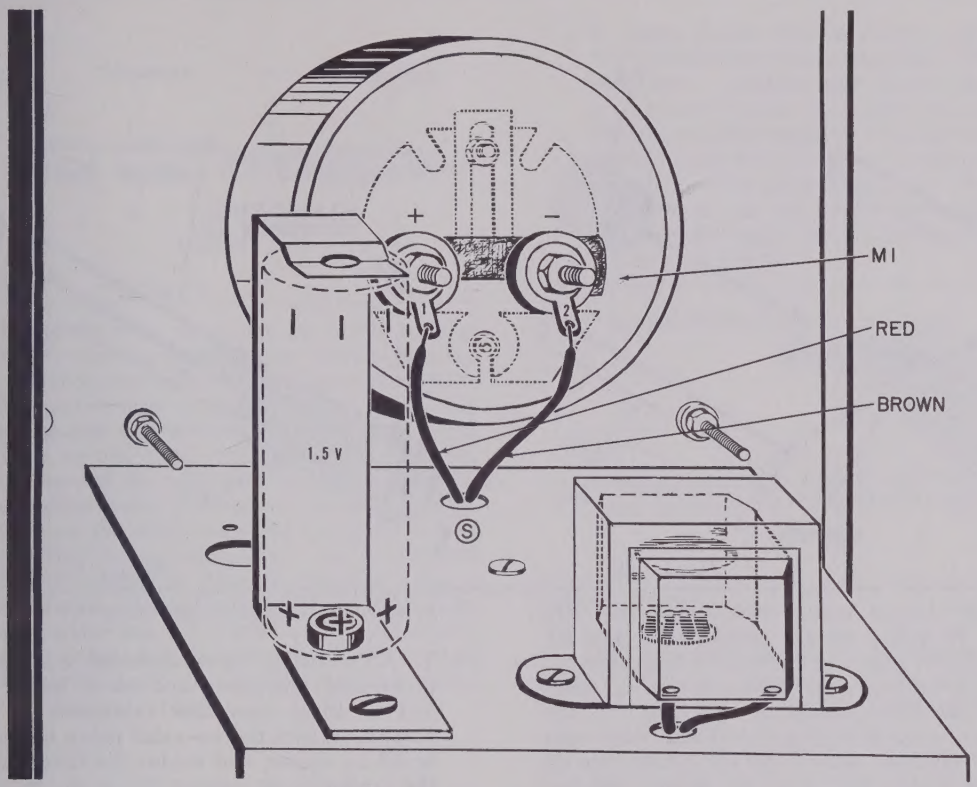



Figure 7. Meter Wiring and Battery Placement

The following steps refer to figure 7.

( ) 1. Connect the red lead from hole "S" to the positive (+) meter lug M1-1 (S1).

( ) 2. Connect the brown lead from hole "S" to the negative (-) lug M1-2 (S1).

Construction and Wiring UNI-PROBE

The following steps refer to figure 8.

( ) 1. Slip the small diameter fiber tube E7, over the metal stud E11, protruding from the nose-piece assembly.

( ) 2. Slip the large diameter fiber washer E8, over E7, and seat it on the blunt-end of the nose-piece E12.

( ) 3. Slip the compression spring E10, over the fiber tube E7.

( ) 4. Hold the spring E10, compressed so that the threaded end of the metal stud E11, is exposed. In the order given, slip the following parts over the threaded end of the stud: the small diameter fiber washer, E9, the brass rotor contact E1, a No. 6 split washer, and a No. 6-32 hex nut. Tighten the nut and then release the spring.
Note: Before proceeding, compress the spring E10. Make certain that the large diameter fiber washer E8, is not caught between the small diameter fiber tube and the blunt end of the nose piece by seeing whether E8 can be moved up E7. Check that the opposite end of the spring is not caught between E7 and the small diameter fiber washer E9 by seeing that this end of the spring can be drawn entirely away from E9.

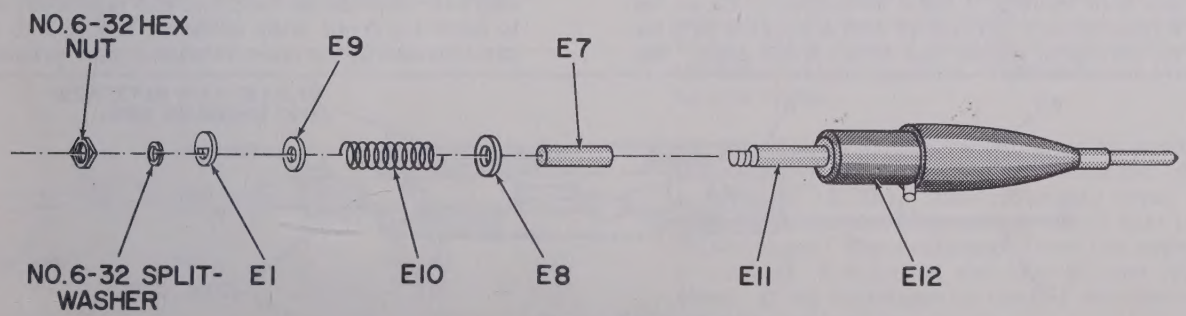



Figure 8a.

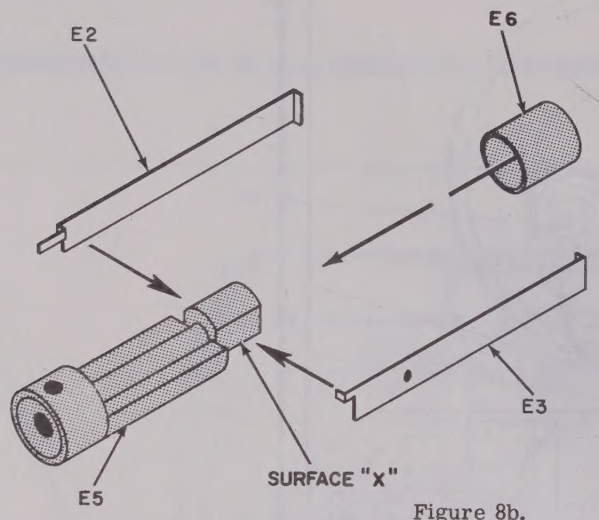



Figure 8b.

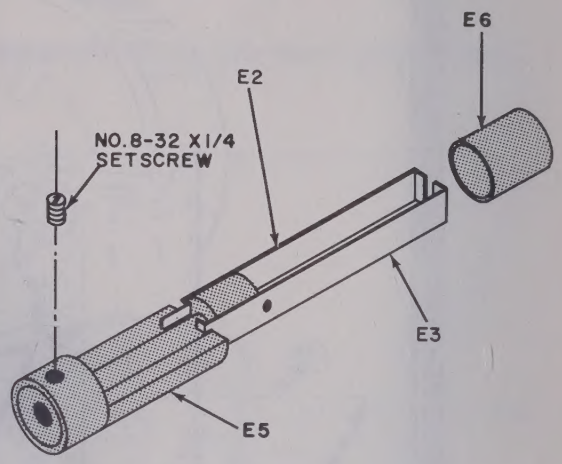



Figure 8b. Detail

( ) 5. Study the figure before proceeding with the assembly. Phosphor-bronze contacts E2 and E3 are shaped differently and may not be interchanged from the relative positions shown in the drawing. E2 and E3 can most easily be told apart by the small hole to be found in E3 but not in E2. Assemble as follows: Hold the black fiber contact holder E5 as shown in figure 8b. Lay E3 against the flat surface "X" of E5, position it as shown and hold it there. Then lay E2 against the parallel surface of E5 underneath, position it as shown and hold E2 in place also. Next catch the free ends of E2 and E3 in the large diameter fiber tube E6, and then move E6 down over E2 and E3 to pin them against the flat surfaces of E5. This is a fairly tight fit and some force is required. E6 should finally rest against the shoulder of E5 past which it can not be moved.

( ) 6. Position the contact holder assembly just completed so that the free ends of contacts E2 and E3 are at the left with E3 (small hole) on top. If the contact holder assembly, positioned as just described, is held at eye level in front of you, it will be seen as shown in figure 8c. Position the body of the 1 megohm resistor R1 as shown, and pass one lead through the small hole in E3. Then trim off the excess lead and solder the connection between R1 and E3. Connect the other lead of R1 to the extension of the bottom contact E2 by first shaping the lead to lay flat against the E2 extension and then bending it back underneath. Close the U-shaped bend in the lead with a pliers to grip the E2 extension firmly and trim off the lead. The connection will be soldered in the next step.

( ) 7. At one end of the co-axial cable strip away 1/2" of outside insulation and outer metal braid and 1/4" of inner insulation to expose the inner conductor. Insert the co-axial cable end so prepared in E5 as shown, and solder the inner conductor to the extension of contact E2, to which one lead of R1 was previously connected. Insert a No. 8-32 x 1/4 (long) set screw into the hole provided for it on E5. Tighten this screw securing the co-ax cable.

( ) 8. Slip the free end of the co-axial cable into the notched end of the probe body E4. Move the probe body down the cable over the contact holder assembly until only the ends of contacts E2 and E3 protrude from it as shown. Push the fiber washer E8 away from the blunt end of the nose-piece, simultaneously compressing spring E10, and hold E8 in this position with one hand. Fold the palm of the other hand around the probe body with the thumb and forefinger of this hand in a position to press the ends of E2 and E3 together. Now align the two sections of the probe as shown in figure 8D, the jaws formed by the ends of contacts E2 and E3 pressed closed on fiber tube E7, between E8 and the blunt end of the nose-piece. Release fibre washer E8 (and the spring) to pin the closed jaws formed by contacts E2 and E3 against the blunt end of the nose-piece but continue to press the jaws closed or one or both of the contacts will slip out. Now use the hand that has just been freed to move the probe body down the contacts to the jaws formed by the ends, releasing your pressure

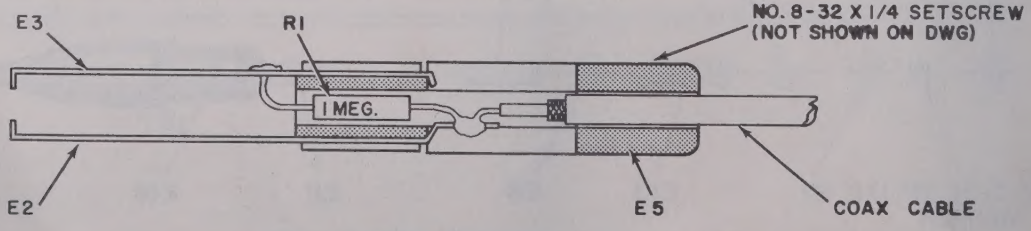



Figure 8c.

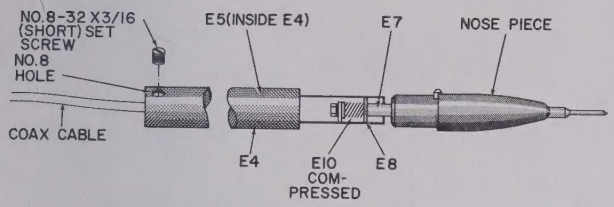


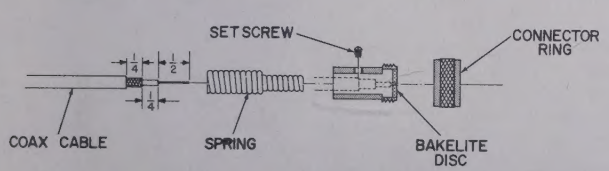

Figure 8d.

on the jaws only when the end of the probe body is sufficiently close to the jaws to ensure that the contacts will not spring free. Then move the probe body down on the nose piece until either one of the notches engages the white pin. Next, grasp the probe body in one hand, and close the 3rd, 4th, and 5th fingers of the other hand about the co-axial cable at a point about 2" from the end of the probe body. Pull on the cable until the emerging end of the black fiber contact holder E5 can be gripped by thumb and forefinger. Maintaining your grip on the cable, rotate E5 until the No. 8 threaded hole is directly under the No. 8 hole in the probe body and insert the No. 8-32 x 3/16 (short) set screw. Turn the screw until its head is just below the surface of the probe body.

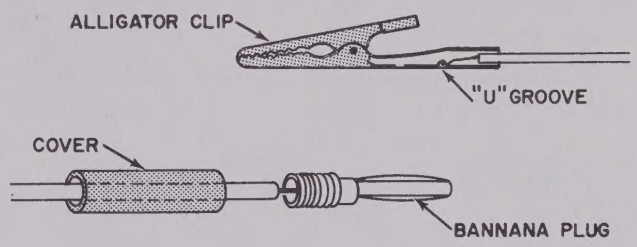
## WIRING OF CONNECTORS

The following steps refer to figure.

( ) 1. Connect the female co-axial connector to the other end of the UNI-PROBE cable as follows: Strip the cable end exactly as shown. Disassemble the connector. Slip the stripped cable end into the larger diameter end of the spring and then solder the small diameter end of the spring to the very edge of the metal braid. Slip the connector ring over the cable end past the spring, unthreaded end first. Pass the cable end thru the tapered end of the connector (threading the inner conductor thru the eyelet in the bakelite disc) until passage is stopped by the larger spring diameter. Tighten the set screw in the connector body so that the cable and spring will be secured mechanically. Solder the inner conductor of the cable to the eyelet in the bakelite disc and trim off excess lead. A section of the internally threaded part of the connector ring should extend past the connector body to enable coupling to the male connector on the panel.




( ) 2. Make up the Ground Cable as follows: Strip 1/2" of insulation from both ends of the black kinkless wire. Connect and solder the alligator clip to one end (crimp U-shaped groove in clip over the insulation to make a firm mechanical connection). Unscrew the cover of the banana plug and slip it over the other end of the wire. Insert this wire end in the terminal hole on the banana plug and solder. Slide the cover to the end of the plug and screw it tight.




## FINAL STEPS

You have now completed the assembly and wiring of your VTVM & Uni-Probe. When you have completed the following steps your unit will be ready for use.

( ) 1. To catch any wiring errors, it is suggested that the entire wiring be checked point-by-point against the wiring instructions (and preferably also against the schematic wiring diagram) in order to become more familiar with the component layout and circuitry. While doing so, check for rosin joints, loose lumps of solder, poor lead dress, and accidental shorts or leakage paths arising from the flow of rosin between contacts. Remove any rosin with a stiff brush dipped in carbon tetrachloride.

( ) 2. Insert the 1/2 Amp fuse in the fuseholder. Snap the battery into the battery bracket with the plus (+) terminal down into the cup washer, as shown in figure 7. Insert the tubes in their appropriate sockets. See the tube layout in the Instruction Book.

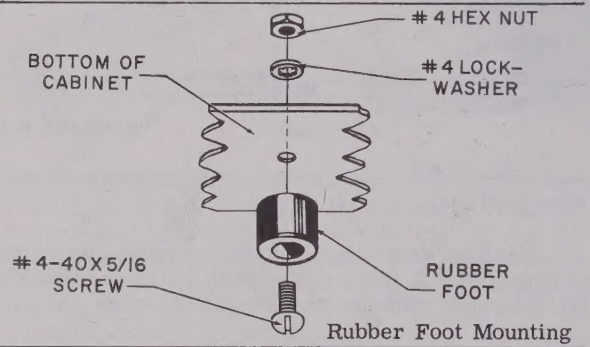
( ) 3. Turn both the FUNCTION and RANGE switches to the maximum counter-clockwise position. Place one large knob over the shaft of the FUNCTION switch with the indicator pointing to OFF and a second large knob over the RANGE switch with the indicator pointing to RX1-3V. Tighten the set screws in both knobs.

Turn the ZERO and OHMS adjust potentiometers to the maximum counter-clockwise positions. Place a small knob over each shaft with the indicator pointing down. Tighten the set screws in both knobs.

( ) 4. With the FUNCTION switch in the AC position, check for a cold resistance of at least 200 ohms across the AC line. The resistance from the positive (+) side of C5 to ground should be at least 40,000 ohms. The resistance from the negative (−) side of C5 to ground should be at least 70,000 ohms. If any resistance is smaller than amounts specified recheck the circuit.

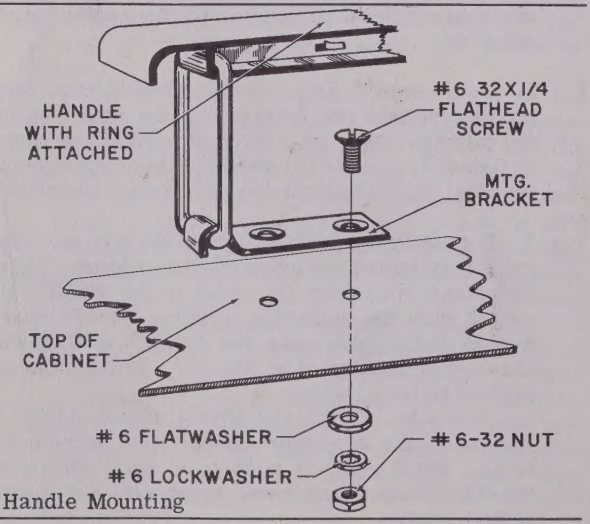
( ) 5. Proceed to Section V (Maintenance) in the instruction section of the manual and carry out the adjustment procedures in paragraphs 5-5 to 5-8. After these adjustments are completed, return to this point and proceed with the remaining steps to complete the assembly of the instrument.

( ) 6. Pass a No. 4-40 x 5/16 screw through the large hole on a rubber foot. Position the screw in one of the four small holes in the bottom of the cabinet. On the inside of the cabinet secure the foot with a No. 4 lockwasher and a No. 4-40 hex nut. Mount the remaining three feet in a similar manner.



Rubber Foot Mounting

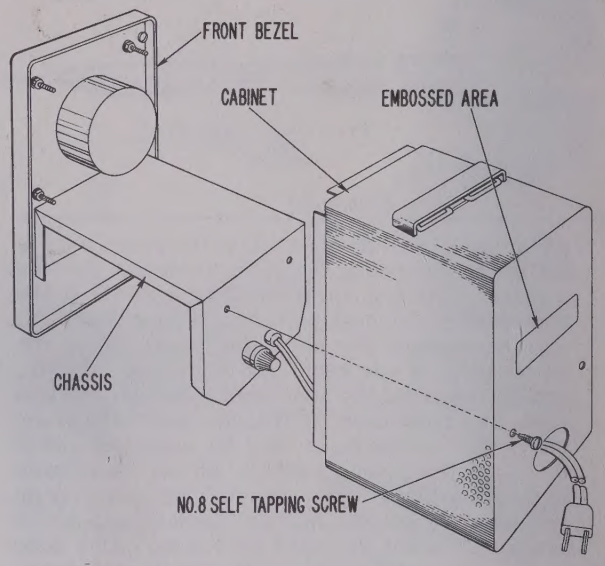
( ) 7. The handle as supplied comes with two rings attached. Place one of the handle mounting brackets over the exposed side of a ring and position on the top of the cabinet. Secure the bracket with two No. 6-32 x 1/4 flat head screws, two No. 6 flat metal washers, two No. 6 lockwashers and two No. 6-32 hex nuts. Secure the other ring and bracket in a similar manner.



Handle Mounting

( ) 8. Remove the backing from the nomenclature label and position in embossed area on rear of cabinet.

( ) 9. Pass the line cord through the large cut-out at the rear of the cabinet. Then slide the unit into the cabinet. When it is properly mounted, the front bezel will fit snugly against the lip around the cabinet. Secure the chassis with two No. 8 self tapping screws at the rear.



Cabinet Assembly

You have now completed building your fine instrument.

## SERVICE

If you are still having difficulty, write to our service department listing all possible indications that might be helpful. Note the code numbers printed in red under the word "Manual" on the front cover. If there is no code number, state this. If desired, you may return the unit to our factory where it will be placed in operating condition for $7.00 plus the cost of part replaced due to their being damaged in the course of construction. This service policy applies only to completed units constructed in accordance with the instructions as stated in the manual. Units that are not completed or are modified will not be accepted for repair. Units that show evidence of acid core solder or paste fluxes will be returned not repaired. NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the unit, giving your home address and the trouble with the unit. Pack very carefully in a rugged container, using sufficient packing material (cotton, shredded newspaper, or excelsior), to make the unit completely immovable within the container. The original shipping carton is satisfactory, providing the original inserts are used or sufficient packing material is inserted to keep the unit immovable. Ship by prepaid Railway Express, if possible, to the:

Service Dept.
Electronic Instrument Co., Inc.
33-00 Northern Blvd.
Long Island City 1, N.Y.

Return shipment will be made by express collect. Note that the carrier cannot be held liable for damages in transit if packing IN HIS OPINION, is insufficient.